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EFFECT ON PROPERTIES OF THE FABRICS PRINTED WITH EUCALYPTUS BARK USING GAMMA IRRADIATION

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ABSTRACT

Having high potentiality in dye yield, gamma irradiation has been found new ways of exploring. In this study, Eucalyptus bark powder and myrobalan treated fabrics are irradiated through different dosages to explore the effectiveness of the dye. The resultant consistency of extract was more with high intensity. Along with improved color fastness properties, the printed samples have shown high absorption levels and intensity of the shade. When analyzed, the cotton fabric dyed with a respective gamma irradiation dosage of Eucalyptus dye source, 500Gy possessed good color strength for after treatment with 3 percent Sodium chloride. Later, by using 500Gy Eucalyptus bark dye and fabric samples were printed with mordants (alum, $FeSO_4$, $CuSO_4$, and $SnCl_2$) and were found to be having good color strength properties.

***KEYWORDS:** Cotton Fabric, Eucalyptus Bark, Irradiation Treatment, Printing & Fabric Properties*

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Original Article

INTRODUCTION

Coloring fabrics were found to be one of the ancient practices. One of the oldest evidence recovered by archaeological is Mohenjo-Daro period's cotton material dyed with Madder along with Indigo from 3rd millennium BCE. From past 150 years, scientists and manufactures have developed many artificial dye sources to dye different types of textiles materials to be suitable for general usage. (https://www.scribd.com/doc/54185948/Textile-Dyeing-and-Printing)

Even though these artificial coloring agents possess many benefits like good fastness, brilliant shades, etc. but are harmful to the environment from the effluents released during the process.

Now the globe is around 'eco' and 'go green' system. This consciousness has driven the scientists towards nature and made them explore new sources for investigation. Working towards an eco-friendly environment, many scientists are exploring and reintroducing natural materials. Natural dyes are one among those. Natural dyes are obtained from a plant, animal or other environmental sources. According to Sachans K and Kapoor V, 2004, Natural dyes will serve as health cure, have no biodegradable and disposable problems. There was no specific standard method for extraction or application of natural dye source; where the Sachans K and Kapoor V, in 2007 have stated that lack of such standards is the major constraints to use natural sources for the dyeing process. This is due to variations in the extraction process for each type of source. Plant's behavior varies differently in temperature exposures and dye can be extracted. Bhatti I A., *et al.* (2010) Millington K R (2000) says that very few studies were done on the fabric dyeing characteristics for both natural and synthetic dye sources, against the effect

of radiation treatment.

According to Saima Naz and Ijaz A Bhatti, 2011, only soluble colorants have maximum absorption by the fabric, but not the impure colorants. Hence, less dye was absorbed by the un-irradiated fabric. And in their study, they have evaluated gamma irradiated Eucalyptus bark dye, not only to improve the extracted dye volume, but also to increase the fastness properties of the fabric.

Depend on the species and classification, the natural dye sources undergo different extraction processes, like, drying, pounding, soaking, skimming, crystallizing, condensing, caking and liquidifying, etc (Shrivastava and Dedhia, 2006; Vankar et al., 2000).

MATERIALS AND METHODS

Eucalyptus bark was selected from the Professor Jayashankar Telangana State Agricultural University’s premises, washed and dried. Then, the bark was ground into powder, sieved and stored. The cotton cambric fabric was sources from a local market and was scoured.

Irradiation

Both fabric and Eucalyptus bark powder were exposed to Gamma irradiation dosages of 100Gy, 300Gy, 500Gy, 700Gy and 900Gy at Irradiation Unit, Quality Control Lab, PJTSAU, Rajendra Nagar, Hyderabad, Telangana, India.

Fabric Evaluation

After evaluating the color strength of the dyed samples, the best Irradiation dosage (500Gy) and the un-irradiated fabric were tested against Tear strength, Fabric count, Thickness and GSM to evaluated the changes that have occurred during irradiation.

Dyeing

The dye was extracted from the irradiated and un-irradiated dye source and was dyed on the respective gamma irradiated dosage fabric for 30 minutes with MLR of 1:30 using $CuSO_4$ as mordant.

After optimizing irradiation dosage, printing was done on the cotton samples using other mordants like alum, $FeSO_4$ and $SnCl_2$.

Printing

From the results obtained, the best dosage was used for further study through printing (Block and Screen). The color strength and subjective evaluation were conducted for the printed samples.

After Treatment

Sodium chloride was used as the exhausting agent with 1, 2, 3, 4 and 5 g/L for after treatment.

Color Strength

Color strength for the test samples was conducted by Clothing & Textiles lab, PJTSAU.

Subjective Evaluation of Printed Samples

The printed samples were evaluated by 30 members for its acceptability through Depth of color, Evenness of

print, Sharpness of print and overall appearance.

RESULTS AND DISCUSSIONS

Fabric Evaluation

Fabric properties were evaluated for the Control and Irradiated myrobalan treated fabric to study its effectiveness towards longevity.

Table 1: Fabric Properties of Control and Irradiated Myrobalan Treated Cotton Material

Sample	Tear Strength		Fabric Count (yarns/sq In.)		Thickness (mm)	GSM
	Warp	Weft	Warp	Weft		
UR	22.6	12.2	85.8	61.8	28.2	0.75
IR	20.6	11.4	87	61.8	26.2	0.742

Note: IR=Control/Un-Irradiated fabric and IR=Irradiated fabric

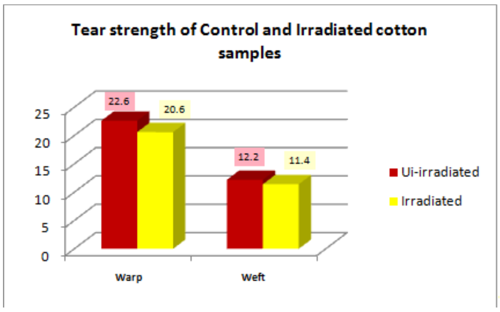

Figure 1: Tear Strength of Control and Irradiated Cotton Samples

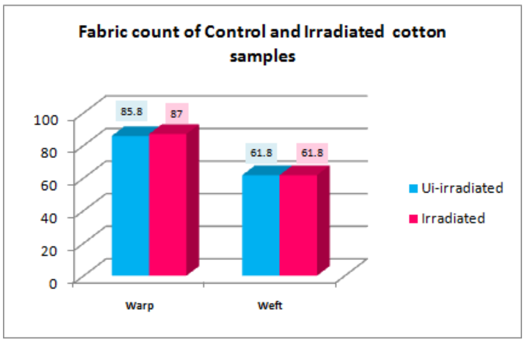

Figure 2: Fabric Count of Control and Irradiated Cotton Samples

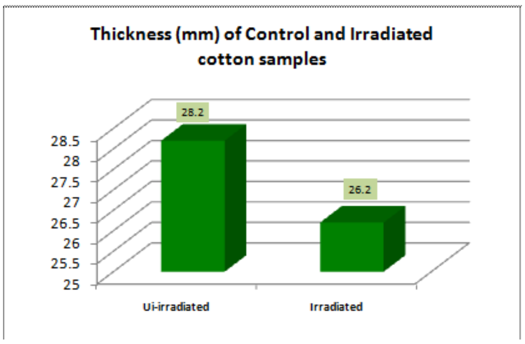

Figure 3: Thickness (mm) of Control and Irradiated Cotton Samples

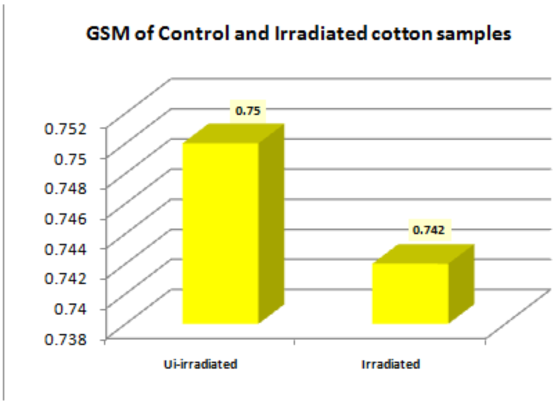

Figure 4: GSM of Control and Irradiated Cotton Samples

Tear strength results revealed that, there was approximately 9 per cent decrease in the strength of irradiated fabric's towards warp direction, where the weft yarns have shown a decrease of 6.5 percent. This may be due to the loss of strength during cell division while irradiation process. There was a slight increase in the warp count for irradiated samples while there was no change was observed in weft direction. About 8 per cent of the decrease in fabric thickness was observed for irradiated samples than un-irradiated samples. There was a very minimal difference in the weights of un-irradiated and irradiated cotton fabric.

Optimization of Dyeing on Irradiated Cotton Fabric with Irradiated Eucalyptus Bark Powder

Natural dyes possess low color, strength through aqueous extraction; this is due to the presence of impurities that do not soluble in the dye and might adhere on the surface of the fabric (Iqbal J. et.al. 2007). Hence, research needs to done to overcome this issue through different means of applying colorant on to fabric.

With this regard, different irradiation dosages for both Eucalyptus bark powder and cotton fabrics were used to evaluate the color strength. The sources were evaluated along with combinations of un-irradiated and irradiated fabrics with un-irradiated and irradiated dye source using $CuSO_4$ as mordant.

Table 2: Color Strength (%) of EBP Dyed Samples with Different Irradiation Dosages

Irradiation Doses	UR EBP on UR- F (Control)	IR EBP on UR - F	UR EBP on IR - F	IR EBP on IR - F
100Gy	100	100	100.5	99
300Gy	100	101	99.5	101
500Gy	100	101.5	100	105
700Gy	100	101.3	99	99.5
900Gy	100	99.5	100.5	102
Note: IR=Irradiated; UR=Un-irradiated; EBP=Eucalyptus bark powder; and F=Cotton fabric				

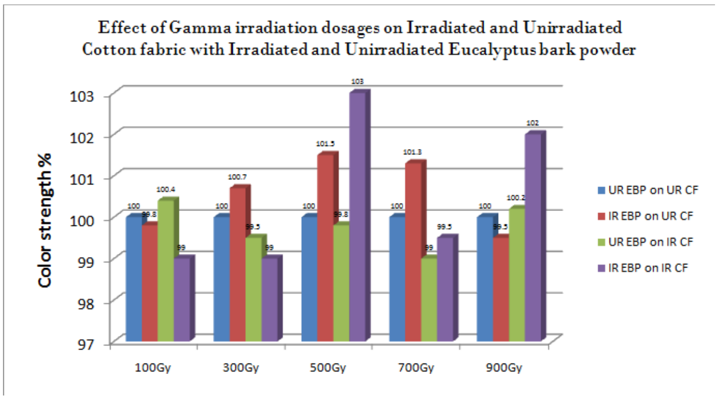

Figure 5: Effect of Gamma Irradiation Dosages on Irradiated and Unirradiated Cotton Fabric with Irradiated and Unirradiated Eucalyptus Bark Powder

Among all the samples, IR EBP on IR CF with 500GY has shown greater color strength. So, 500 Gy dosages were selected for further study. **Takacs E, Et al. 2000** says that, the higher irradiation dosage makes the fabric to absorb impurities also and results in poor color strength.

Dye Extraction Time

When dye extraction time was optimized between 40 to 45 minutes. At this point, complete colorant was extracted from the source.

Material Liquor Ratio

The optimum MLR for extraction of dye was found to be 1:30, here the maximum color strength of 170 per cent increase in the color strength was observed up to1:30 MLR. Later on increase in material liquor ratio, the decrease in the color strength was noticed; this may be due to the poor concentration of dyestuff.

Table 3: Color Strength Result for Varying Percentage of Material during Dyeing

M:L:R	Color strength %
1:10	100
1:20	150
1:30	170
1:40	130
1:50	110

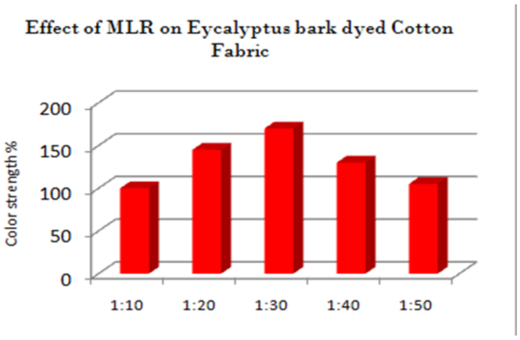

Figure 6: Effect of MLR on Eycalyptus Bark Dyed Cotton Fabric

After successful trials with dyeing, the samples were printed using four mordants, Ferrous Sulphate ($FeSO_4$), Copper Sulphate ($CuSO_4$), Stannous Chloride ($SnCl_2$) and Alum

Printing with Mordant's and their Concentrations

Table 4: Color Strength of Printed Samples with different Mordants

Mordant (%)	Color Strength (%)			
	$FeSO_4$	$CuSO_4$	$SnCl_2$	Alum
1	100.2	100.7	97.6	97
2	100.8	101	98.2	97.5
3	101.2	99	97.2	101.5

Among all the concentrations 2 per cent $FeSo_4$, 1 per cent $CuSO_4$, and 3 per cent Alum were found to be better mordant's to yield best colors. Except for alum, all the mordants have shown a decrease in the color strength with an increase in the mordant percent. When Alum further evaluated, 8 to 10 per cent of it is giving good color strength properties. A difference in color fixation was noticed among four mordants.

After Treatment

Table 5: Color Strength of Salt Concentration

Sodium Chloride (g/L)	Color Strength (%)
1	75
2	70
3	104
4	83
5	90

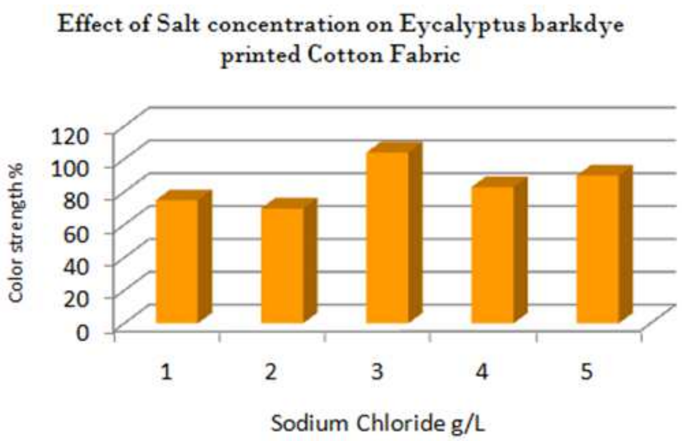

Figure 7: Effect of Salt Concentration on Eycalyptus Barkdye Printed Cotton Fabric

Among all the quantities, 3g/L Sodium Chloride was optimized as good exhausting agent for after treatment and its color strength were good.

Subjective (Visual) Evaluation of Printed Samples

Table 6: Visual Evaluation of Printed Samples with Eucalyptus Bark Powder Dye Un-Irradiated and Irradiated Fabrics

Sl. No.	Sample	Depth of Color	Eveness of Print	Sharpness of Print	Overall Appearance
1	**UI-F-Sc**	4.5	4.5	4.2	4.2
2	**IR-F-Sc**	4.7	4.6	4.5	4.7
3	**UI-F-B**	3.3	3.1	3.2	3.1
4	**IR-F-B**	3.5	3.5	3.3	3.6
5	**UI-C-Sc**	2.9	2.8	2.4	2.8
6	**IR-C-Sc**	3.4	3.4	3.2	3.2
7	**UI-C-B**	3.0	2.8	2.9	3.1
8	**IR-C-B**	2.7	2.5	2.8	3.6
9	**UI-Sn-Sc**	2.3	2.7	2.7	2.7
10	**IR-Sn-Sc**	3.1	3.3	3.3	3.1
11	**UI-Sn-B**	1.8	1.9	2.2	2.0
12	**IR-Sn-B**	1.9	1.8	1.9	2.2
13	**UI-A-Sc**	2.5	2.0	3.1	2.8
14	**IR-A-Sc**	3.0	3.0	3.2	3.1
15	**UI-A-B**	2.0	2.2	2.3	2.4
16	**IR-A-B**	2.9	3.0	3.1	3.0

Note: UI - un-irradiated myribalan treated cotton sample; IR - irradiated myrobalan treated cotton sample; F - $FeSO_4$; C - $CuSO_4$; Sn - $SnCl_2$; A - Alum; B - Block printing; Sc - Screen printing

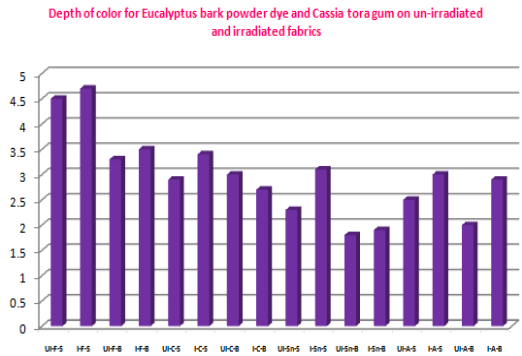

Figure 8: Depth of Color for Eucalyptus Bark Powder Dye and Cassia Tora Gum on Un-Irradiated and Irradiated Fabrics

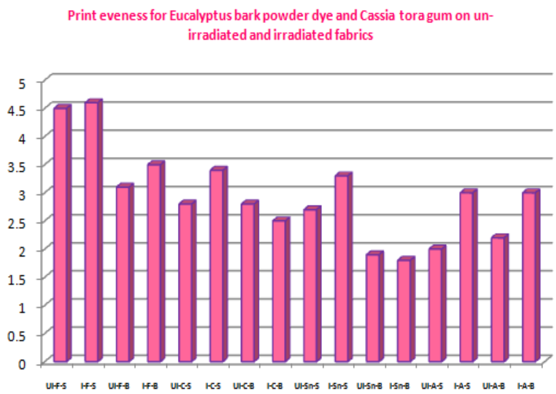

Figure 9: Print Eveness for Eucalyptus Bark Powder Dye and Cassia Tora Gum on Un-Irradiated and Irradiated Fabrics

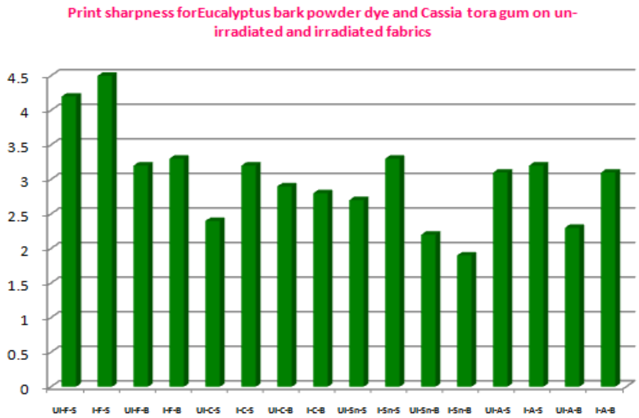

Figure 10: Print Sharpness for Eucalyptus Bark Powder Dye and Cassia Tora Gum on Un-Irradiated and Irradiated Fabrics

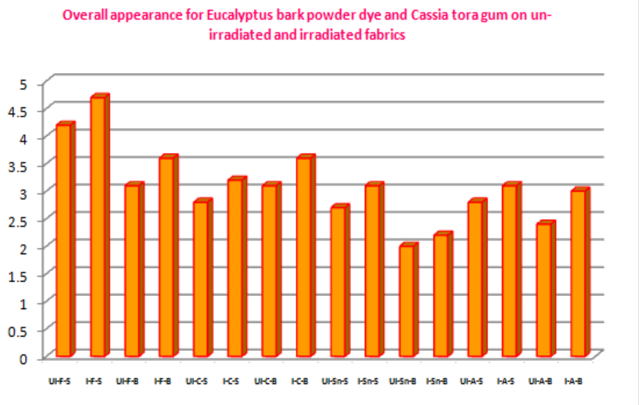

Figure 11: Overall Appearance for Eucalyptus Bark Powder Dye and Cassia Tora Gum on Un-Irradiated and Irradiated Fabrics

Among all printed samples I-F-Sc has shown good color depth, print evenness and sharpness. Irradiated samples printed with any type of mordant have shown good visual evaluation results compared with their respective un-irradiated samples. Samples with SnCl2 have shown poor aesthetics than all other mordant treated samples irrespective to irradiated or un-irradiated fabric and dye.

CONCLUSIONS

By using gamma radiations, a dyer can obtain comparatively good results in color shade, intensity and strength of the selected dye source by adequately maintaining the usage of mordant, temperature, time, etc. Gamma irradiation not only increases the depth and strength of the color, but also improves its fast properties.

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